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APPLICATION

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TITLE WIRE BONDING METHOD AND APPARATUS

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WIRE BONDING METHOD AND APPARATUS

Field of the Invention:

The present invention relates to large scale integrated circuit manufacture and, more particularly, to an improved method and apparatus for bonding wire to a circuit device supported by an improved base laminate that increases the resistance of the circuit device to deform.

BACKGROUND OF THE INVENTION

In recent times, as large scale integrated circuits have become denser, the copper wires in the pads have become ever thinner. Working with such thin wires, placing and attaching them to appropriate sites, has thus become ever more challenging.

During assembly, the pads are supported by a mesh laminate, while a capillary tool is used to attach the fine wiring onto the pads. As the tip of the capillary tool

wipes across the surface of the pad in order to clean it, then applies heat, while pushing the wire to bond or weld the wires to the pad, it has been discovered that pads collapse or deform. The collapse of the pads is due to the interaction of the copper wire thickness, copper hardness, total pad thickness, force of the capillary tool, and material construction of the base laminate. Previous solutions to this problem involved changing the wire bonding parameters, but this had the disadvantage of producing a weaker bonded product.

Copper wire in the pads has reached a thickness of less than 0.7 mils in order to provide for finer circuit lines and greater density. Experiments revealed that with the gold and nickel parameters of the pad being held constant, changing the base laminate could resolve the problem.

After pad collapse, windows of relatively thick resin had been observed in the open weave of the laminate, where the glass strands of the laminate supported the pad. This led to the conclusion that changing the laminate from an open weave to a closed weave could decrease or eliminate the likelihood of pad collapse.

It was discovered that the closed weave laminate improved the interaction of the pad thickness, such that copper thicknesses as low as 1.0 - 1.5 mils could be used without pad failure. The inventive process reflects the discovery that mesh with a separation dimension between warp or weave strands, measured lengthwise through the laminate, must be less than or equal to the diameter of the copper wires, in order to avoid pad collapse. The closed weave of the laminate was observed to improve the interaction of the pad thickness for thinner applications.

Discussion of Related Art:

In United States Patent No. 4,848,639, issued on July 18, 1989 to Belanger, Jr. for COMPLIANT PAD FOR USE IN TAPE AUTOMATED BONDING PROCESS, a work piece used in bonding the inner leads of an integrated circuit is illustrated. The work piece is constructed of a metallic base layer to which a compliant pad is affixed. A gas channel is provided for a source of heated nitrogen. A ceramic layer is positioned over the gas channel to provide for heat distribution and support of the integrated circuit during its bonding to an

associated tape.

In United States Patent No. 5,092,510, issued on March 3, 1992 to Anstrom et al. for METHOD AND APPARATUS FOR CIRCUIT BOARD SUPPORT DURING COMPONENT MOUNTING, a temporary support fixture is depicted for mounting components to selected locations on a circuit board. The fixture features a flexible support to provide for variations and tolerance differences between the circuit board and placement head.

In United States Patent No. 5,562,948, issued to Trepte et al. on October 8, 1996 for METHOD AND APPARATUS FOR PRODUCING AN ELECTRICALLY CONDUCTIVE WALL FROM A FABRIC AND A SHEET MATERIAL, a fabric and film are provided with an insulating coating in the production of flexible containers.

In Japanese Publication No. JP 1222950, a laminated board is shown with a conventional glass cloth, epoxy resin and inorganic filler, used in printed circuit boards.

In Japanese Publication No. JP 62294546, a laminate is formed by impregnating a fluoro-resin fabric with a resin varnish comprising a polyimide or epoxy resin.

In German Publication No. DE 3716531, a laminated material is formed in a continuous process by passing a resin impregnated fabric and copper foil between a sandwiching set of rollers.

In Publication No. SU 1062233, a resin impregnated, heat resistant fabric laminate is fabricated from an arylene-phenol-formaldehyde resin, an epoxy-triphenol resin, a tris-(dimethyl aminomethyl) - phenol, and an organic solvent.

SUMMARY OF THE INVENTION

In accordance with the present invention, there is provided a process and apparatus for bonding wire to a circuit device in large scale integrated circuitry. The circuit device is supported by a closed weaved laminate base that increases the resistance of the circuit device to deform during the wire bonding process. The laminate comprises a woven, fiberglass mesh having a separation dimension between warp or weave strands, measured lengthwise through the laminate, less than or equal to that of the

diameter thickness of the copper wires of the circuit device. The diameter thickness of the copper wires of the circuit device is generally less than 0.7 mils. The improved laminate base can accommodate circuit devices having copper wires whose thicknesses are as low as 1.0 - 1.5 mils, without circuit device deformation.

It is an object of this invention to provide an improved method and apparatus for fabricating circuit devices.

It is another object of the invention to provide an improved supporting base laminate in a wire bonding process in the manufacture of large scale integrated circuits.

BRIEF DESCRIPTION OF THE DRAWINGS

A complete understanding of the present invention may be obtained by reference to the accompanying drawings, when considered in conjunction with the subsequent detailed description, in which:

FIGURE 1 illustrates a schematic diagram of the apparatus used in the wire bonding process of this invention, featuring the area of pad collapse;

FIGURE 2 shows a schematic, cross-sectional view of the base support of the apparatus of FIGURE 1;

FIGURE 3 depicts a plan view photograph of an actual collapse of a circuit pad using a prior art laminate mesh;

FIGURE 4 shows a sectional view photograph of an actual collapse of a circuit pad using a prior art laminate mesh;

FIGURE 5 illustrates a schematic, in situ view of the circuit pad disposed upon a supporting mesh of the prior art; and

FIGURE 6 illustrates a schematic, in situ view of the circuit pad disposed upon the supporting mesh of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Generally speaking, the invention features a process and apparatus for wire bonding large scale integration circuit devices. The bonding process employs a capillary tool that applies heat and pressure to the wires in order to bond or weld them to the circuit device. The circuit device, or pad, is supported upon a closed woven, fiberglass mesh, which supports the circuit device during the bonding process.

Now referring to FIGURE 1, a schematic view of the apparatus 10 used in the bonding process of this invention is illustrated. A wire 12 is shown being bonded to the circuit pad 14 by a capillary tool 16, whose tip is approximately 6 to 10 mils in diameter. The circuit pad 14 is approximately 50 mils thick. The circuit pad 14 rests upon a laminate mesh 18 which, in turn, is supported by a substrate 20, depicted in FIGURE 2. The mesh is between approximately 2.5 to 4.0 mils thick.

In the prior art, the circuit pad 14 was supported upon a laminate base, or mesh 18, of the type shown in FIGURE 5.

The prior art supporting mesh 18 comprised an open weave, which did not adequately support the circuit pad 14, and which resulted in collapse of the pad 14 about the area designated A. Photographs of the collapsed area A, in plan and sectional views, is shown in FIGURES 3 and 4, respectively.

It has now been discovered that a closed woven mesh 22 of the type that is schematically shown in FIGURE 6, can adequately support the pad 14 from collapse during the wire bonding process.

The mesh 18 of the invention comprises a woven fiberglass having a separation dimension "X" (FIGURE 5), measured lengthwise, between warp or weave strands 24 or 26, of no more than the diameter (thickness) of the copper wires of the circuit pad 14. The diameter of the copper wires of the circuit pad 14 is generally between 1.0 and 1.5 mils, and can even be less than 0.7 mils. The improved mesh base can accommodate circuit pad devices having wires whose thicknesses are as low as 0.2 mils, without circuit device deformation. The fiberglass mesh of this invention can be purchased from Clark-Schwebel, Inc., of Anderson, South

Carolina, and is sold as Model No. 2116.

Since other modifications and changes varied to fit particular operating requirements and environments will be apparent to those skilled in the art, the invention is not considered limited to the example chosen for purposes of disclosure, and covers all changes and modifications which do not constitute departures from the true spirit and scope of this invention.

Having thus described the invention, what is desired to be protected by Letters Patent is presented in the subsequently appended claims.